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20 July 1981

USSR Report

PHYSICS AND MATHEMATICS

No. 70

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JPRS 78551

20 July 1981

USSR REPORT

PHYSICS AND MATHEMATICS

No. 70

CONTENTS

LASERS AND MASERS

NUCLEAR PHYSICS

OPTICS AND SPECTROSCOPY

OPTOELECTRONICS

PLASMA PHYSICS

MATHEMATICS

UDC 534.27

PASSAGE OF AN ACOUSTIC WAVE THROUGH THE BOUNDARY BETWEEN TWO SOLID MEDIA

Tashkent IZVESTIYA AKADEMII NAUK UZBEKSKOY SSR: SERIYA FIZIKO-MATEMATICHESKIKH NAUK in Russian No 2, 1981 pp 59-63 manuscript received 30 Jun 80

DZHANGIRYAN, R. G., BLINDERMAN, M. S. and REZNIK, Ye. K.

[Abstract] The problem of reflection and refraction of a plane transverse acoustic wave at the boundary between two solid media is analyzed, with continuity of the displacement vector and of the stress tensor components stipulated as the boundary conditions. A system of equations is obtained for the amplitudes of transverse and longitudinal reflected and refracted waves, with the displacement vector in each medium expressed as the sum of longitudinal and shear waves 1) parallel to the boundary and 2) in the plane of incidence, and with the wave vectors expressed through the sines of the corresponding angles. The solution yields a sixth-order transcendental equation which cannot be evaluated analytically. A numerical evaluation indicates that "sliding" of the incident wave along the boundary as well as total reflection can occur in acoustics, the latter when the displacement vector of the transverse incident wave lies in the plane of incidence. Data obtained for several metals and ceramic materials in all combinations of pairs reveal that for porcelain-Plexiglas and glass-Plexiglas pairs there are two angles of incidence at which the transverse reflected wave will have only one component: parallel to the plane of the boundary. Figure 1, tables 2. [195-2415]

UDC 534.222.2:551.596.1

ESTIMATION OF THE NONLINEAR EFFECTS DURING VERTICAL PROPAGATION OF NONMONOCHROMATIC ACOUSTIC RADIATION THROUGH THE ATMOSPHERE

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 3: FIZIKA I ASTRONOMIYA in Russian No 2, Mar-Apr 81 pp 28-33 manuscript received 19 Mar 79

KULICHKOV, S. N., Moscow State University, Chair of Atmospheric Physics

[Abstract] Generation of a difference-frequency harmonic during upward vertical propagation of nonmonochromatic acoustic radiation through the atmosphere is analyzed in the approximation of three-wave interaction, for an evaluation of

the conversion to low-frequency radiation in the upper layers. At some altitude above ground dissipation begins to predominate over nonhomogeneity so that attenuation becomes strong and the effects of stratification due to density differences become insignificant. There is also some corresponding altitude above which discontinuities in the form of shock waves can appear in the primary radiation. The dimensionless equation of wave propagation for nonlinear acoustics is, accordingly, solved first for the region below this critical altitude and then for the region above it. Energy conversion in the upper layers is found to reach a saturation, with the amplitude of the difference-frequency harmonic tending toward a constant magnitude dependent only on the frequency mismatch. Reverse energy conversion from the difference-frequency harmonic to the primary wave is also possible, after the amplitude of the former has become larger than the amplitude of the latter. The beginning of nonlinear effects depends largely on the Knudsen number, which also determines the critical Mach number. Figures 2, references 6 Russian.
[197-2415]

UDC 534.12

FOCUSING OF SOUND BY A LIQUID SPHERE

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 3: FIZIKA, ASTRONOMIYA
in Russian Vol 21, No 6, Nov-Dec 80 pp 97-100 manuscript received 27 Mar 80

MAKARCHENKO, N. N., ROZHIN, F. V. and TONAKANOV, O. S.

[Abstract] It has been experimentally and theoretically shown that acoustic energy can be concentrated in water by a liquid sphere with parameters different from those of water. Exact solution of the wave equation has been used to calculate the fields of pressure and intensity on the axis of the sphere in the internal region, and also the sound pressure at the focus as a function of the angle of incidence of a plane acoustic wave. Research has also been done on the focusing properties of Luneberg lenses. It has been shown that simple sphere are superior to Luneberg lenses with respect to amplification and directionality of certain values of kr_0, where $k = 2\pi/\lambda$, λ is the wavelength and r_0 is the radius of the sphere. In this paper a more detailed analysis is made of the field of diffraction by a liquid sphere. The pressure field for diffraction of a plane sound wave by a liquid sphere is determined by solving the boundary value problem for the wave equation. Radial and angular dependences of the near field of diffraction are calculated for kr_0 from 5π to 10π in the case of equal densities of the sphere and the medium as the index of refraction is varied from 1 to 2 (the index of refraction is taken as the ratio of the speed of sound outside of the sphere to that inside of the sphere). Absorption was disregarded. Special functions were derived from recurrence relations. Figures 3, references 8: 2 Russian, 6 Western.
[159-6610]

UDC 534.222.2

EXCITATION OF ACOUSTIC PULSES BY DISTRIBUTED SOURCES MOVING AT TRANSONIC VELOCITY

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 27, No 2, Mar-Apr 81 pp 213-219
manuscript received 13 Mar 80

GUSEV, V. E. and KARABUTOV, A. A., Moscow State University imeni M. V. Lomonosov

[Abstract] An investigation is made of the influence that acoustic nonlinearity has on the space-time structure of a sound signal stimulated by a moving source. Excitation of plane waves by volumetric thermal sources in a medium moving at near-sonic velocity is described by an inhomogeneous equation of simple waves with frequency difference, using dimensionless variables for the sake of convenience. The phase plane method is used to analyze the homogeneous unsteady problem of transonic gas flow around the heat-release zone. It is shown that acoustic perturbations with characteristic scale shorter than the dimension of the region of heat release can be produced in the supersonic mode. The demonstration is based on the relation between the duration of the acoustic pulse and the time of action of the thermal sources. The time for reaching maximum amplitude is determined for different flow conditions. Figures 3, references 9 Russian. [167-6610]

UDC 5344534.231.2

OPERATION OF A VERTICAL LINEAR ANTENNA IN SHALLOW WATER

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 27, No 2, Mar-Apr 81 pp 228-233
manuscript received 27 May 80

YELISEYEVNIN, V. A., Acoustics Institute imeni N. N. Andreyev, USSR Academy of Sciences

[Abstract] In a previous article, the author studied the directionality of an extended horizontal linear antenna located in a uniform layer of water with ideally reflecting boundaries [see V. A. Yeliseyevnin, AKUSTICHESKIY ZHURNAL, Vol 25, No 2, 1979, pp 227-233]. The acoustic field in the water was determined by the normal wave method, and the dimensions of the antenna were taken as comparable to or greater than the thickness of the water layer. Under certain conditions, maxima could be observed on the antenna response curve corresponding to individual normal waves propoaating in the layer. The author now analyzes the analogous problem for a vertical antenna with length less than or equal to that of the water layer. It is assumed that the layer is homogeneous, plane-parallel and has ideally reflecting boundaries (surface ideally soft, bottom ideally hard). The acoustic field is produced by a nondirectional point source emitting an audio signal. Sensitivity is constant with respect to length of the antenna, and the phase front of the antenna can be turned through a given angle.

The acoustic signal is represented as the sum of normal waves. A method is proposed for distinguishing normal waves by mapping the acoustic field relative to the boundaries of the layer, and this method is compared with the method of spatial filtration of normal waves. Figures 3, references 5: 3 Russian, 2 Western.
[167-6610]

UDC 534.26

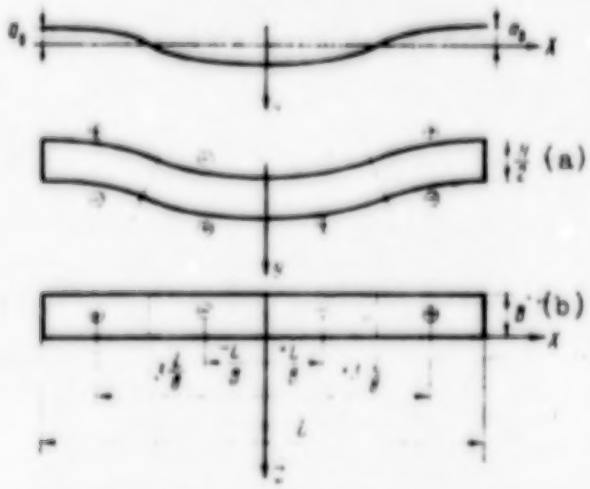
EMISSION OF SOUND BY A ROD-LIKE SURFACE UNDERGOING OSCILLATIONS IN THICKNESS WITH INVARIABLE WIDTH

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 27, No 2, Mar-Apr 81 pp 296-299
manuscript received 26 Sep 80

RZHEVKIN, S. N., deceased, Moscow State University imeni M. V. Lomonosov

[Abstract] An analysis is made of acoustic emission by a rod-like surface oscillating as shown schematically in Fig. 1. Length L is taken as much greater than width B and height H. An approximate approach is used for calculating radiation power that is suitable for a rod of rectangular cross section where the transverse dimensions have small wave dimensions and emission can be represented as the sum of emissions from a number of point sources. The rod is assumed to oscillate in thickness in the second antisymmetric mode, and end corrections for the distribution of oscillations are disregarded. Expressions are derived for the intensity of sound on the axes of partial radiation patterns, and for the total radiation power at a given velocity of oscillations. The radiation pattern of the rod is shown in Fig. 2.

Figure 1



Form of the oscillating rod from the side looking along the x-axis (a); location and polarity of sources on the upper surface of the rod looking along the y-axis (b)

Figure 2

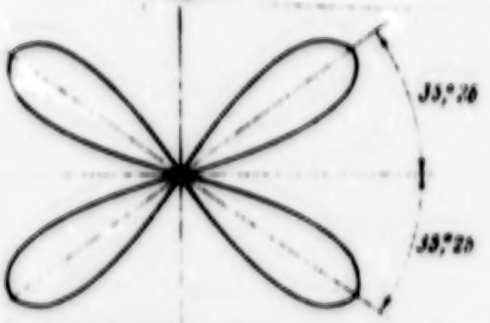


Fig. 2. Radiation pattern of the oscillating rod

Figures 2.
[167-6610]

UDC 534.231.1

TRANSMISSION OF ACOUSTIC IMAGES OVER NATURAL WAVEGUIDES OF THE SEA

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 27, No 2, Mar-Apr 81 pp 315-317
manuscript received 25 Feb 80

SEMENOV, A. T., All-Union Scientific Research Institute of Physical Optics Measurements

[Abstract] Optical multimode waveguides of some types have the capability of reproducing the image of an object located in the input section in a discrete sequence of so-called cophased sections. This effect should be observable in all spectral bands of the electromagnetic spectrum, and also for multimode propagation of sound over natural waveguides of the sea. In this paper the author examines the feasibility of complex image transmission to great distances by this effect. The analysis is based on determining conditions of cophasality in Epstein and Eckart asymmetric layers. The results show that image transmission by this method should be possible with acoustic signals in waveguides of the sea, and with optical images in natural atmospheric waveguide layers.
References 4 Russian.
[167-6610]

OPTICAL PROPERTIES OF SOLID SOLUTIONS OF $TlIn_xGa_{1-x}Se_2$ (x=0.1-0.5) IN THE VICINITY OF THE FUNDAMENTAL ABSORPTION EDGE

Baku IZVESTIYA AKADEMII NAUK AZERBAYDZHANSKOY SSR: SERIYA FIZIKO-TEKHNICHESKIKH I MATEMATICHESKIKH NAUK in Russian Vol 1, No 4, 1980 pp 71-73 manuscript received 15 Jun 80

BIDZINOVA, S. M., GUSEYNOV, G. D., ABDINBEKOV, S. S. and ALIYEV, R. A., Institute of Physics, AzSSR Academy of Sciences

[Abstract] Methods of physicochemical analysis are used to study the interaction of ternary compounds of $TlGaSe_2$-$TlInSe_2$. The phase diagram of this system is a quasibinary eutectic diagram with broad regions of solubility. Single crystals of solid solutions of $TlIn_xGa_{1-x}Se_2$ (x=0.1-0.5) were grown by the Bridgman technique, and their optical properties were studied in the region of the chief absorption edge at room temperature. Plots of the coefficient of absorption as a function of $h\nu$ show a gradual increase in absorption followed by a sudden jump (attributed to direct optical transitions) for all solid solutions. These crystals are layered materials, and therefore it was necessary to process the measurements to exclude the influence of multiple reflections inside the specimens. When this was done, it was found that there is an abrupt jump in the coefficient of reflection in the region of the fundamental absorption edge. Calculations of the width of the forbidden band from optical and electrophysical measurements show good agreement. Figures 3, references 11: 7 Russian, 4 Western. [164-6610]

UDC 621.396

SPATIAL-POLARIZATION FILTERING OF ELECTROMAGNETIC WAVES

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 3: FIZIKA I ASTRONOMIYA
in Russian No 2, ar-Apr 81 pp 12-15 manuscript received 13 Feb 79

BEREZIN, Yu. V. and TALITSKIY, A. N., Moscow State University, Chair of General Physics and Wave Processes

[Abstract] Filtration of electromagnetic waves of the same frequency is considered by combining the spatial (angle of incidence) and the polarization methods. The feasibility of achieving this with a system which includes two polarization filters and one space filter is examined in the specific case of four partly scattered waves, having all the same frequency but each a different angle of incidence and a different polarization, two of them constituting a two-beam signal and the other two constituting a two-beam interference. Both signal and interference are assumed to be stationary, uniform, and mutually noncorrelated processes. A delta-correlated and completely nonpolarized additive noise is, furthermore, assumed to appear at the antenna input. Two possible processing schemes are considered. In one scheme the polarization filters suppress the first interference beam and the space filter suppresses the second interference beam as well as the interference component of the field due to a correlation between both beams. In the second scheme the polarization filters suppress the first interference beam as well as the interference component of that field and the space filter suppresses the second interference beam. Both schemes are evaluated in terms of the gain in the signal-to-noise ratio at the output relative to the maximum signal-to-noise ratio at the input. This gain is found to depend in general on the aggregate of signal and interference characte istics. Each scheme, therefore, will be preferable under different conditions. Figure 1, references 5: 2 Russian, 3 Western.
[197-2415]

UDC 539.101

DIFFRACTION OF A PLANE ELECTROMAGNETIC WAVE ON AN ANISOTROPIC SPHERE

Yer van IZVESTIYA AKADEMII NAUK ARMYANSKOY SSR: FIZIKA in Russian No 1, Jan-Feb 81 pp 37-43 manuscript received 26 Apr 80

OGANESYAN, S. S. and BAREGAMYAN, V. A., Yerevan Institute of the National Economy

[Abstract] An analysis is made of the problem of wave diffraction by a sphere. It is assumed that a uniaxial sphere of given radius is located in an infinite isotropic medium with given permittivity and permeability. It is assumed that the permeability of the sphere is different from that of the medium, and the permittivity is given as a diagonal tensor $\hat{\varepsilon}$ with components ε_0, ε_0, ε_z in a cartesian coordinate with origin on the axis of the sphere and the z-axis directed along the axis of anisotropy of the sphere. A plane linearly polarized electromagnetic wave propagating along the z-axis is incident on the sphere. The authors study the influence that anisotropy of the spherical crystal has on the diffracted and scattered fields in terms of the transverse scattering cross section as a function of the coefficient of anisotropy $p = \sqrt{\varepsilon_z/\varepsilon_0}$. Maxwell's equations for an anisotropic medium are solved by the method of constructing spherical vector functions. References 6: 5 Russian, 1 Western. [174-6610]

UDC 621.396.67

SIGNAL RESOLUTION BY ANTENNA ARRAYS

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 3: FIZIKA, ASTRONOMIYA in Russian Vol 21, No 6, Nov-Dec 80 pp 49-55 manuscript received 1 Dec 78

BUROV, V. A. and DMI'RIYEV, O. V.

[Abstract] An examination is made of problems of signal resolution as applied to discrete antenna arrays: minimum resolvable angular distance between sources, maximum number of resolvable signals, type of signal processing for optimum resolution. A statistical approach is used in which signal resolution is reduced to verification of statistical hypotheses. The analysis assumes signal reception by a linear equidistant antenna array consisting of a given number of elements. The signal sources are taken as independent, and the signals themselves are assumed to be narrow-band gaussian processes with the same bandwidth. Reception takes place against a background of additive gaussian interference. An algorithm of resolution is proposed that reduces to constructing a quadratic form from elements of an initial sample, and determination of its sign. For sufficient averaging time, this algorithm can surpass the Rayleigh limit of resolution and come close to the potential resolution. References 8: 6 Russian, 2 Western. [159-6610]

UDC 931.

DISCHARGE STABILITY IN PULSED LASERS WITH CONVECTIVE COOLING OF THE WORKING FLUID

Moscow TEPLOOBMEN 1978: SOVETSKIY ISSLEDOVANIYA in Russian 1980 (signed to press 9 Jul 80) pp 445-455

KAMNYUSHIN, V. N. and SOLOUKHIN, R. I., Institute of Heat and Mass Exchange, BSSR Academy of Sciences

[Abstract] An analysis is made of processes that determine the duration of the volumetric phase of a discharge under typical operating conditions of pulse-periodic flow-through gas lasers. The key process of discharge dynamics is energy exchange between the electronic and gas components of the working fluid, in which the electrons receive energy from the applied field and transmit it to the gas molecules with resultant excitation and ionization. The authors analyze evolution of the resultant volumetric discharge with emphasis on the aspect of local heat exchange in the zone of small-scale inhomogeneities. A model is considered that accounts for the development of instability with consideration of overheating and ionization under conditions of a self-maintained pulse discharge in dense gases. It is shown that localized stability of a discharge is increased with a reduction in gas density, so that under certain conditions the heating of gas in the cathode layer might be a stabilizing factor. Thus it is concluded that the stability and homogeneity of a volumetric discharge can be modified by a change in gas density due to heating of the boundary layer near the cathode, or by changing the composition through additives in the electrode region. Experiments are described in which the effect that these factors have on discharge stability is studied. The results show that discharge stability in this class of lasers can be considerably influenced by gasdynamic processes as well as by phenomena of energy and mass exchange and heat transfer. More research is needed on the specific part played by processes in the vicinity of the electrode, since it has been demonstrated that these processes determine the nature and magnitude of initial perturbations. Figures 4, references 9: 2 Russian, 7 Western. [173-6610]

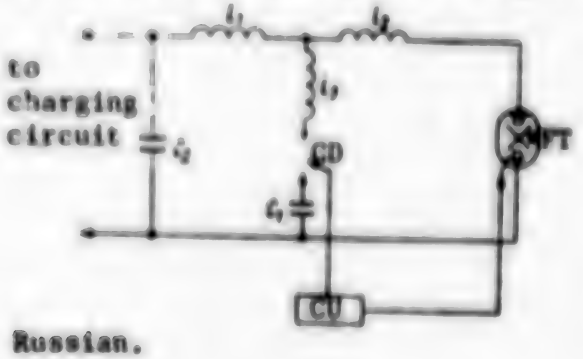
UDC 621.327

OPTIMIZING CURRENT PULSE SHAPE IN LASER PUMPING TUBES

Minsk IZVESTIYA AKADEMII NAUK BSSR: SERIYA FIZIKO-MATEMATICHESKIKH NAUK in Russian No 2, Mar-Apr 81 pp 60-64 manuscript received 18 Jun 80

BOYKO, B. B., VALYAVKO, V. V., MOZGO, A. A., PETROV, N. S. and SOYKA, A. K., Institute of Physics, BSSR Academy of Sciences

[Abstract] A supply circuit is proposed for tailoring the current pulse through flash tubes used for laser pumping to maximize service life under severe operating conditions ensuring maximum pumping intensity close to the maximum population inversion. It is shown that the optimum pulse shape realizing these objectives has a prolonged rise time and a steep trailing edge. The shaping circuit is shown in the diagram. The control circuit CU synchronizes operation of the controllable discharger CD with ignition of the flash tube FT. An analysis is made of the processes occurring in the circuit. Experiments were done with a pulse shaper having the following parameters: L_1 = 19.2 μH, L_2 = 42 μH, L_3 = 4.4 μH, C_1 = 400 μF, C_2 = 300 μF and resistance of the load (lamp) R = 0.2 Ω. This supply circuit produced pulse energies as much as 20% higher than the rated value without detrimental effects on service life of flash tubes.



Figures 3, references 7 Russian.
[175-6610]

FAST WAVE OF GAS IONIZATION IN INTENSE LASER BEAM

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 79, No 6(12), Dec 80 pp 2142-2151 manuscript received 12 Feb 80

FISHER, V. I., Astronomical Observatory, Odessa State University imeni I. I. Mechnikov

[Abstract] There are four known modes of transfer of the zone of absorption of laser emission along the laser beam: breakdown, light-detonation, radiative and thermally conductive. Theoretical and experimental investigations of these modes of transfer have shown that the velocity of the wave front D is a weaker

than linear function of the intensity of laser radiation q_0: $D \sim q_0^s$, $1/3 < s < 1$. The experimentally observed dependence of D on q_0 with faster than linear increase ($s = 2$-3.5) [see V. A. Boyko et al., KVANTOVAYA ELEKTRONIKA, Vol 5, 1978, p 216] shows that there is yet another "fast" mode of wave front propogation. In this paper the author investigates this "fast ionization wave" and calculates the threshold, structure and pattern of wave propagation. It is shown that when the intensity of laser emission exceeds the threshold $\tilde{q}$, the plasma temperature T* behind the wave front decreases with increasing intensity, and the function $D(q_0)$ is stronger than linear. A diagram is given showing the typical structure of a fast ionization wave in hydrogen with $N_0 = 9 \cdot 10^{20}$ cm^{-3}, neodymium laser intensity of $q = 20$ GW/cm^2. The discovery of the fast ionization wave mode of transfer of the zone of absorption has implications for selection of the optimum mode of implosion of gas targets in laser-driven fusion. Figures 4, references 16 Russian.
[162-6610]

LIMITATION OF BRIGHTNESS OF THE OUTPUT BEAM OF A LASER AMPLIFIER WITH SPACE FILTERS AND TERMINAL DISK AMPLIFICATION STAGES

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA FIZICHESKAYA in Russian Vol 45, No 3, Mar 81 pp 659-662

ALEKSEYEV, V. N., BORDACHEV, Ye. G., KUZ'MINA, N. V., ZHILIN, A. N., ROZANOV, N. N., SMIRNOV, V. A., STARIKOV, A. D. and CHERNOV, V. N.

[Abstract] A report to the Second All-Union Conference on Laser Optics, Leningrad, 4-8 January, 1980. The paper gives preliminary results of an investigation of propagation of a laser beam in a six-stage amplifier with a terminal disk stage made up of 8 active elements 23 mm thick. The aperture of the last rod stage was 75 mm. The active elements were made of GLS-21 and GLS-22 phosphate glass. The master laser was a single-mode unit with spectrum selection and stabilization of wavelength on 1.054 μm. A KDP Pockels cell cut out a pulse of 0.5 ns duration at half-amplitude. A beam with energy of 235 J was produced with duration of 0.8 ns. Of the total beam energy, 80% was concentrated in an angle of 0.75 mrad. The angular distribution of energy is narrower in a low-energy pulse. For pulse energy of about 30 J, calorimetric measurements show that 95% of the energy is concentrated in an angle of $3 \cdot 10^{-4}$ rad. Figures 4, references 4 Russian.
[166-6610]

UDC 621.378.325

CW LASER WITH FIBER-OPTICS CAVITY

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 3: FIZIKA, ASTRONOMIYA in Russian
Vol 21, No 6, Nov-Dec 80 pp 23-27 manuscript received 1 Dec 78

ZABELIN, A. M., ISAYEV, S. K., KORNIYENKO, L. S. and FIRSOV, V. V.

[Abstract] The current stage of development of low-loss fiber optics enables the use of light guides as laser cavity components. This technique enables variation of the characteristics of optical cavities over a wide range analogously to the insertion of a delay line. Experiment has shown that the use of a fiber-optics cavity enables stimulation of a single light-guide wave in a multimode fiber. Such an element also can be conveniently used in a ring laser to attenuate the interaction of opposed waves. By studying the energy and spectral-time characteristics of a laser with fiber-optics resonator an analysis can be made of both the linear and nonlinear dynamics of fiber optics. In this paper the authors describe a cw garnet laser with a multimode quartz light guide connected in the optical cavity. One mirror of the resonator is applied directly to the end face of the light guide. The emission leaving the other end of the guide is collimated by an objective lens and reflected back to the light guide by a spherical mirror. Optimum conditions for excitation of a given mode can be brought about by varying the distance between the lens and the end of the light guide. In this way the laser can be tuned from one transverse mode to another. Formulas are given for calculating cavity losses for various media. Figures 2, references 6: 4 Russian, 2 Western.
[159-6610]

UDC 621.378.32:535.241.13

DYNAMICS OF STIMULATED EMISSION OF SOLID-STATE LASERS WITH FARADAY MODULATOR IN THE OPTICAL CAVITY

Minsk IZVESTIYA AKADEMII NAUK BSSR: SERIYA FIZIKO-MATEMATICHESKIKH NAUK in Russian
No 6, Nov-Dec 80 pp 64-69 manuscript received 28 Feb 80

BURAKOV, V. S., VOKHONOV, A. F. and ZHUKOVSKIY, V. V., Institute of Physics, BSSR Academy of Sciences

[Abstract] Emission characteristics of a neodymium glass laser are studied as a function of parameters of the optical cavity, and also as a function of frequency and rate of Q-switching by a Faraday modulator in the cavity. It is shown that the duration and power of resonance spiking can be determined from these parameters. Experiments are done with a flash-pumped neodymium laser using a cavity formed by a flat and a spherical mirror. Lasing and pumping pulses were monitored by photomultipliers and a two-beam oscilloscope. The magneto-optical elements were rods of heavy flint or terbium glass with Verdet constants of 0.08 and

0.125 angular minute/oersted·cm respectively. They were placed in a solenoid in which the magnetic field was induced by discharged capacitors. Activation of the Faraday modulator converted the random pulsations of emission to resonance spiking. Analysis of the time parameters of the stimulated emission showed that the laser parameters can be determined from measurements of the lasing characteristics, and confirmed the theoretical part of the work. Figures 3, references 11: 10 Russian, 1 Western.
[156-6610]

UDC 621.375.826

INVESTIGATION OF HEAT FIELD DYNAMICS IN TRANSIENT OPERATION OF A SOLID-STATE LASER

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 34, No 3, Mar 81 pp 410-415 manuscript received 20 Nov 79, after revision 8 Oct 80

BUCHENKOV, V. A., MIKHAYLOV, Yu. N., SOMS, L. N., STEPANOV, A. I. and FISHER, A. M.

[Abstract] An analysis is made of the dynamics and configuration of the heat field ($T(\xi,t)$) in the active element of a solid-state laser for the case of nonuniform distribution of heat release ($Q(\xi)$) over the cross section. The nonuniformity of $Q(\xi)$ is taken to be one-dimensional: varying either with respect to the thickness of a plate or with respect to the radius of a cylindrical active element. This is a valid approximation for pumping with diffuse reflectors. The theoretical analysis is based on conventional simplifications: steady-state heat release, transverse dimension of the active element at least an order of magnitude shorter than the length, and specifically a plate element is equivalent to an infinite plate, and a cylindrical element is equivalent to an infinite cylinder. Analysis of the dynamics of the temperature field is based on solution of the unsteady equation of heat conduction with boundary conditions of the third kind. It is shown that nonuniform pumping distribution limits the time capabilities for reaching the quasisteady state by forcing the pumping power in the initial period of the cycle. Figures 3, references 5: 3 Russian, 2 Western.
[163-6610]

EVALUATION OF THE DIFFERENTIAL CROSS SECTION OF ELASTIC SCATTERING OF NEUTRONS FROM ALUMINUM

Baku IZVESTIYA AKADEMII NAUK AZERBAYDZHANSKOY SSR: SERIYA FIZIKO-TEKHNICHESKIKH I MATEMATICHESKIKH NAUK in Russian Vol 1, No 4, 1980 pp 87-92 manuscript received 10 May 78

ABDULLAYEV, Kh. Sh., Azerbaijan State University imeni S. M. Kirov

[Abstract] An evaluation is made of the differential cross section of elastic scattering of neutrons from aluminum based on the optical model of the nucleus. The data of the ENDL-2 library were used to obtain the parameters of the optical potential, supplemented by experimental data. The method of processing experimental data to get the initial differential cross sections of elastic scattering of neutrons is explained. The theoretical cross sections for the optical model were calculated in the spherical potential approximation. The calculated optical parameters are tabulated for neutron energies from 3 to 14 MeV. References 11: 8 Russian, 3 Western.
[164-6610]

UDC 533.9.01

ACCELERATION OF SOLID HYDROGEN PELLETS IN THE JET OF A PLASMA GUN

Moscow FIZIKA PLAZMY in Russian Vol 7, No 1, Jan-Feb 81 pp 213-217 manuscript received 2 Jul 79, after revision 5 Jun 80

VORONOV, G. S., Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] A recent concept in fusion reactor fueling is the use of solid hydrogen pellets. In this paper, acceleration by a plasma jet is suggested as an alternative to the gas gun, centrifuge, linac and laser beam techniques that are now being seriously considered. The advantages of this method are wide-range controllability of the rate of energy supply to the pellet surface by varying the plasma parameters in the jet, and high density and velocity of the plasma: $n_e \sim 10^{17}$ cm^{-3} and $v \sim 10^7$ cm/s. It is shown that the plasma jet method can get the pellets to the central fusion zone before they vaporize. Hydrogen pellets with radius of 0.5 mm can be accelerated to $5 \cdot 10^5$ s without breaking up, since the acceleration parameters can be controlled to prevent forces that exceed the mechanical strength of solid hydrogen. The proposed technique is well within the reach of present technology. Figures 2, references 14: 3 Russian, 11 Western.
[158-6610]

NEW EQUIPMENT FOR TESTING ASTRONOMICAL MIRRORS DESCRIBED

Moscow TEKHNIKA I NAUKA in Russian No 12, Dec 80 p 6

[Article by D. Puryayev, doctor of technical sciences: "To Capture Light from Distant Stars"]

[Text] The modern telescope is a complicated, expensive device. And the most critical element in it is the main mirror, which most often has the shape of a concave paraboloid. High quality of the image of the objects being viewed through the telescope can be achieved only under conditions where the mirror has an ideally precise geometric shape. Admissible deviation from the theoretical paraboloid cannot exceed a fraction of the length of a light wave, that is, tenths of a micrometer.

And now imagine that, with just such precision, a mirror with a diameter of 6 m, the surface area of which is more than the area of a modern two-room apartment, must be made and tested. The interference method is used to accomplish this complicated task. Only this method permits clear and accurate evaluation of the geometry of the mirror and brings out flaws in its shape, their size and significance.

The essence of the method is the comparison of two wave fronts. One of them -- the one being analyzed -- is formed by beams reflected from the surface being tested, and the other, from a reference standard. Where both fronts meet, an interference pattern arises. And although its dimensions are small -- about 15 to 20 mm in diameter -- it provides information on the whole gigantic surface of the mirror. A special optical element -- a compensator -- helps to receive it in such a compressed form. How this is accomplished is evident from figure 1. Beams from a point source of light, A, pass through the compensator, K, and are further strictly directed along normals to the standard, practically ideal parabolic surface, P; they are reflected from it, repeat their path in reverse, and enter the interferometer, I, where the analysis of the wave front takes place. If the real mirror is installed in place of the reference standard, distortions in its surface (errors), on a doubled scale, will pass into the wave front being analyzed, which will immediately be reflected in the interference pattern: instead of straight bands, there will be deformed ones (fig. 2) and, instead of geometrically true rings, distorted ones.

To evaluate the essence of the new development, it must be noted that compensators that have existed heretofore have not only been very complicated in design but also have had strictly individual purposes -- each of them was intended only for testing the single mirror for which it was designed and built. After the fabrication of

the mirror, this expensive instrument, to put it simply, has been thrown away. Moreover, not one of the known compensators could meet the requirements for quality control for a mirror designed for large telescopes having a 4- to 6-meter diameter.

Long research by Soviet scientists has led to the creation of a general-purpose compensator of conceptually new design with a unique combination of useful characteristics achieved for the first time in the world practice of mirror testing. The basic characteristics among these are the following.

Simplicity: the maximum diameter of the lenses does not exceed 115 mm, the length is no more than 260mm, and the mass of all optical components together is 1.9 kg. One can understand the size and mass only by comparison. One that was used earlier for the testing of large mirrors, the Offner compensator, had a length of about 4 m, the diameter of the lenses was 300 mm, and a lifting crane was needed to install it.

The optical system of the device that has been created consists of two groups of lenses: meniscus and convexo-convex (or convexo-plane). The first (see fig. 1) is made in the form of the two lenses, 1 and 2, the spherical surfaces having equal radii, which provides the possibility for testing the accuracy of their shape by reciprocal positioning in the manufacturing process. The accuracy of the plane surfaces of these lenses is tested in an analogous manner.

The second consists of one lens, 3, with a diameter of 115 mm, having only a spherical (or plane and spherical) surface and therefore relatively simple to make and easily subjected to testing. The lenses, therefore, introduce practically no errors in the evaluation of mirror quality.

One of the most valuable characteristics of the compensator, however, is not just the simplicity of design but the universality of its application. It is suitable for checking parabolic, hyperbolic, and elliptical mirrors with a diameter of from 500 to 6000 mm and, whatever their dimensions, its design remains unchanged.

The general-purpose compensator has still another extremely important quality. Earlier, not one of the known designs of this type could be tested after the final assembly. And, however scrupulously it was produced, the lenses of the optical system could be pinched in the mounting or warped. It is now sufficient to direct a parallel pencil of rays at the completed compensator from the side of lens 3 (see fig. 1) and test it with an interferometer. If the interference bands are straight, it means that the lenses have been made precisely and the assembly has been correct.

Figure 1. Diagram of the Optics of the Compensator

Key:
1. P 2. I

Figure 2. Interference Pattern from a Mirror Being Tested

In connection with the creation of the unique Large Azimuthal Telescope (BTA), which is now constructed in the mountain region of the Karachayevo-Cherkasskaya Autonomous Oblast, it was decided to use two alternative pieces for the main 6-m diameter mirror. The basic mirror was made with the application of equipment of previous design, the second -- a reserve mirror -- under testing by the general-purpose compensator which had just been created at that time. And, although the first mirror basically met the requirements, the second turned out to be significantly better in all-around quality and, particularly, in the precision of manufacture. It was installed in the BTA.

It must be noted that the general-purpose compensator created by scientists at the Moscow Higher Technical School imeni Bauman in creative cooperation with a number of organizations and enterprises can be applied not only to test precise surfaces of astronomical mirrors but is suitable also for testing individual lenses, components, and assemblies for various optical systems. Using it, one can also test the trueness of the shapes of relatively crude elements such aspherical metallic reflectors widely applied in solar facilities and projectors.

9645
CSO: 1862/177

UDC 535.33/.34

OPTIMIZING THE OPTICAL CHARACTERISTICS OF MULTILAYERED SELECTIVE COATINGS

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 34, No 4, Apr 81 pp 749-751
manuscript received 23 Jun 80

KOLTUN, M. M. and GAVRILOVA, I. P.

[Abstract] The authors consider methods of making multilayered selective coatings with maximum ratio α_s/ε, where α_s is integral absorptivity in the region of the solar spectrum and ε is the degree of blackness of the coating. Some of the techniques that maximize this ratio are vacuum sputtering of alternate dielectric and semitransparent metallic layers, electrochemical deposition of black layers, and simultaneous vacuum sputtering of a metal and a dielectric to produce cermet coatings. The ratio of α_s/ε is calculated as a function of film thickness for the three types of coatings on a copper heat receiver at temperatures of 27-500° C. It is found that selective coatings can be produced by these techniques with $\alpha_s/\varepsilon > 30$ as compared with the value of about 18-19 for currently produced coatings. The electrochemical and cermet coatings have much higher ratios α_s/ε than the vacuum-sputtered alternating layers of semitransparent metal and dielectric. This is attributed to the peculiar structure of absorbing metal particles uniformly distributed in a transparent dielectric matrix, which maximizes the selectivity of optical properties of these coatings. The results of the analysis are qualitatively confirmed in experiments. Figure 1, references 9: 6 Russian, 3 Western.
[170-6610]

UDC 551.521.3:551.574.12

ATTENUATION AND BACKSCATTERING OF RADIATION BY SYSTEMS OF TWO-LAYERED AND THREE-LAYERED PARTICLES OF ATMOSPHERIC AEROSOL

Minsk IZVESTIYA AKADEMII NAUK BSSR: SERIYA FIZIKO-MATEMATICHESKIKH NAUK in Russian
No 2, Mar-Apr 81 pp 71-76 manuscript received 16 Jun 80

ASTAF'YEVA, L. G., PRISHIVALKO, A. P. and KATSEVA, I. R., Institute of Physics, BSSR Academy of Sciences

[Abstract] One way of controlling the condensation formation or dispersal of clouds and fog is to alter the optical properties of the water droplets by using

surfactants. Such a process converts the aerosol particles from homogeneous to two-layered or three-layered particles, changing the light-scattering properties of the entire system. In this article the authors study the range of possible changes in the attenuation factor and backscattering of such aerosol systems when films of various substances are formed on the particles, and also the conditions that maximize the effect of these films. Light-scattering properties are compared for systems of water particles simulating a wet fog, and also for atmospheric condensation nuclei that are partly or totally covered with water. The properties of such systems are compared before and after the formation of surfactant films. It is shown that polydisperse systems of three-layered particles consisting of water-covered particles of atmospheric aerosol enclosed in a surfactant shell attenuate incident radiation most strongly if they are finely dispersed and the index of refraction of the outer surface layer is fairly high. Figures 4, references 12: 9 Russian, 3 Western.
[175-6610]

ACOUSTO-OPTICAL MODULATORS WITH ANISOTROPIC DIFFRACTION OF LIGHT

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA FIZICHESKAYA in Russian Vol 45, No 3, Mar 81 pp 636-639

BALAKSHIY, V. I., Moscow State University imeni M. V. Lomonosov

[Abstract] A report to the Second All-Union Conference on Laser Optics, Leningrad, 4-8 January, 1980. A theoretical analysis is made of acousto-optical modulators with anisotropic diffraction of light. The major emphasis is on optimizing the geometry of acousto-optical interaction to maximize bandwidth and modulation efficiency. The calculation reduces to solution of the problem of diffraction of a limited light beam by an amplitude-modulated acoustic wave. The effect of the light beam on the acoustic field is disregarded, and the analysis is restricted to a linear section of acousto-optical interaction. It was assumed that the angles of incidence and diffraction are less than 10°. The field of the diffracted light is found by using Fourier transformation to expand the incident light beam in a series of plane waves. The distribution of the light field at the modulator output is then found by summing all diffracted waves. It is shown that anisotropic light diffraction can expand the modulation bandwidth and appreciably improve the efficiency of interaction of light waves and acoustic waves. Figures 3, references 3: 2 Russian, 1 Western.
[166-6610]

UDC 535.416.3

FAST FOURIER TRANSFORMATION IN PROBLEMS OF THERMAL SELF-STRESS

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 3: FIZIKA, ASTRONOMIYA in Russian Vol 21, No 6, Nov-Dec 80 pp 27-31 manuscript received 15 Dec 78

CHESNOKOV, S. S.

[Abstract] The comparatively recent development of an algorithm for fast Fourier transformation has enabled the use of spectral methods in solving nonlinear partial differential equations. In this paper the author discusses the applicability of this technique to problems of diffraction and self-stress of light beams with complex initial intensity distribution. First it is demonstrated that discrete Fourier transformation can be used to study diffraction of a restricted light beam. Then an algorithm is described for solving the nonlinear equation of steady-state propogation of a light beam in a moving nonlinear medium. The problem of matching beam dimensions to the size of the region of solution of the equation is considered with regard to practical calculation of beam propagation in the case of complex configuration. An example is given of application of the proposed technique to propagation of a focused beam of square cross section. Analysis of beam propagation in the near zone shows that the diffraction effect on the initial section play an appre iable part in formation of the temperature profile of the medium, thus determining thermal distortions of the beam. Figure 1, references 2: 1 Russian, 1 Western.
[159-6610]

UDC 681.7.064.43

OPTIMIZATION OF MULTILAYERED OPTICAL INTERFERENCE COATINGS

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 34, No 3, Mar 81 pp 497-500 manuscript received 9 Apr 80

LIKHOLETOV, A. V. and AKHMADEYEV, M. Kh.

[Abstract] An examination is made of major quality criteria for widely used types of interference coatings. Quality functions are derived for optimizing the antireflection coatings of neutral beam splitters and achromatic optical elements, and also for spectral separation components with a wide high-reflectance zone. The proposed functions can be conveniently computerized, and solutions can be required to conform to a predetermined spectral function and to minimize chrominance in given sections of the spectral band. An example is given demonstrating the capability for eliminating short-wave backgrounds in the high-reflectance zone of a spectral divider while simultaneously enhancing transmission in the adjacent long-wave zone. Figures 2, references 13: 7 Russian, 6 Western.
[163-6610]

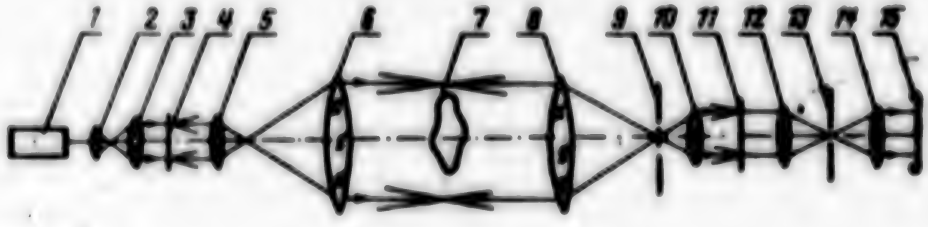
UDC 535.853.4

HOLOGRAPHIC INTERFEROMETER WITH DIFFRACTION GRATING

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russ. Vol 34, No 3, Mar 80 pp 534-536
manuscript received 23 Jan 80

SPORNIK, N. M.

[Abstract] The author describes a holographic single-exposure interferometer for studying inhomogeneities in transparent media under conditions of strong vibrations. A diagram of the facility is shown in the figure. The interferometer contains diffraction grating 4 that is optically linked to the study specimen and splits the beam three ways. These three beams correspond to the plus and minus first orders and the zeroth order of diffraction of light by the grating. As they pass through inhomogeneity 7 placed between lenses 6 and 8, the signal beams are focused by lens 8 in the plane of space iris 9 that samples the signal beams and produces the reference beam. The signal beams are sampled by large apertures in the iris, and the reference beam is shaped by a small aperture with diameter smaller than the circle of confusion of lens 8. The wave fronts from the hologram are reconstructed by one of the light beams of plus or minus first order of diffraction. The reconstructed waves propagating along the normal to the surface of the hologram interact to produce the interference pattern, which is recorded on film 15, optically linked to the hologram 11 by lenses 12 and 14.



[Figure caption]:
1--laser
2--lens
3, 5, 10--condenser lenses
4--diffraction grating
6--collimator
7--inhomogeneity
8--reception objective
9--space iris
11--hologram
12, 14--image inverter
13--iris
15--film

Figure 1, references 4 Russian.
[163-6610]

UDC 534.8

DEFLECTION OF LIGHT BEAMS IN A CRYSTAL OF GALLIUM PHOSPHIDE BY THE ACOUSTO-OPTICAL METHOD

Tashkent IZVESTIYA AKADEMII NAUK UZBEKSKOY SSR: SERIYA FIZIKO-MATEMATICHESKIKH NAUK in Russian No 2, 1981 pp 64-67 manuscript received 23 Jan 80

MAMATDZHANOV, F. D., AZAMATOV, Z. T., PARYGIN, V. N., VOLOSHINOV, V. B. and TASHPULATOV, Kh. Z., "Order of Labor's Red Banner" Institute of Cybernetics with Computer Center, UzSSR Academy of Sciences

[Abstract] In the design of optical computers there must be provisions made for controlling the spatial position of a light beam. Acousto-optical devices based on diffraction of light beams by ultrasonic waves have been found to combine a very high deflection efficiency of nearly 100% with less than 1 W control power and a high speed approaching 10^{-6} s with up to 10^3 position elements. Here the performance of such a device is analyzed theoretically, considering that either Bragg diffraction or Raman-Nat diffraction will occur depending on the angle of incidence of the light beam and on the frequency of the ultrasonic wave. An intermediate mode of diffraction may be required for obtaining the widest possible scanning frequency band and thus the maximum possible resolution. An experimental study was made using two GaP cubic crystals with an $LiNbO_3$ (X-cut) piezoelectric transducer each, one transducer 33 μm thick for a natural frequency of 72 MHz and one transducer 20 μm thick for a natural frequency of 104 MHz, and an He-Ne laser with a light beam at the $\lambda = 633$ nm wavelength. The optical diffraction angle and the acoustic velocity in the crystal were measured at the $f_0 = 71$ MHz ultrasound frequency. The performance characteristics of both deflectors, namely their diffraction efficiency (20 and 15% respectively) and their scanning bandwidth (46 and 49 MHz respectively) with a control (electric) power of 1 W, correspond to a speed of 3.6 μs of each deflector with 165 resolvable position elements for the 72 MHz deflector and 175 resolvable position elements for the 104 MHz deflector. An examination of the diffraction pattern has confirmed the feasibility of realizing an intermediate mode for optimum performance, with only the transducer as the limiting factor. Figures 3, references 5: 3 Russian, 2 Western.
[195-2415]

UDC 621.039.66

DIAGNOSIS OF THE INITIAL SEGMENT OF A PLASMA JET

Tashkent IZVESTIYA AKADEMII NAUK UZBEKSKOY SSR: SERIYA FIZIKO-MATEMATICHESKIKH NAUK in Russian No 2, 1981 pp 72-74 manuscript received 12 Dec 79

ARIFOV, T. U., VASIL'YEVA, Ye. K., GRUICH, D. D. and RYSKIN, B. V., Institute of Electronics imeni U. A. Arifove, UzSSR Academy of Sciences

[Abstract] The initial segment of a plasma jet in a plasma accelerator was diagnosed, in a study of cathode erosion under pulse and quasi-steady conditions, for the purpose of establishing a relation between the appearance of erosion products in the jet and the mode of cathode surface breakdown. In the experimental low-current plasma accelerator a tungsten cathode was mounted coaxially inside a tungsten-molybdenum anode, with a solenoid around producing a magnetic field 1000 Oe strong. The accelerator was put inside a chamber 6 m^3 large evacuated to 10^{-3} mm Hg. Argon was used as the working substance at a rate of 0.1 g/discharge, a discharge of 250 μs duration producing an arc current of 150 A under quasi-steady conditions. Two hollow cathodes of identical shapes were used in the experiment, one made of polycrystalline tungsten and one made of single crystal tungsten. The spectrum of the plasma jet contained within the 4000-7000 Å range not only Ar-I and Ar-II lines but also H_α and H_β lines as well as H_2 bands. The tungsten content in the jet after 100 discharges was determined by spectral analysis on the basis of the intensities of Ar-II (4348 Å) and W-I (4294 Å), the most likely transition, and by electron-microscope examination of the cathode surface. The relatively slight erosion of a polycrystalline cathode appears to follow a weakening of the surface film. The relatively heavy erosion of a single crystal appears to also involve thermal fatigue effects with formation of elliptic craters on the surface. Faint traces of tungsten in the spectrum may be misleading, however, inasmuch as heavy breakdown of the cathode results in an ejection of macroscopic particles of metal in addition to measurable atomized particles. Figures 2, table 1, reference 1 Russian.
[195-2415]

UDC 533.922

LIMITING INTENSE BEAM-WAVE STATE IN PLASMA

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 3: FIZIKA I ASTRONOMIYA in Russian No 2, Mar-Apr 81 pp 8-12 manuscript received 7 Feb 79

GRISHIN, V. K., IVANOV, S. T., Bulgaria, and KANEVSKIY, M. F., Scientific Research Institute of Nuclear Physics, Moscow State University

[Abstract] Equations derived by the authors in an earlier study (VESTNIK MOSK. UNIV., SER. FIZ. I ASTRON, No 1, 1981 pp 11-14) and describing the nonlinear beam-wave state in a plasma are here analyzed for information content. First an analog of the dispersion equation and an expression for the particle capture ratio are obtained applicable to nonrelativistic beams. Then the redistribution of beam energy during generation of a wave field is determined and the efficiency of generation is calculated. The analysis is also extended to relativistic beams, in accordance with the linear theory. On this basis, estimates can be made pertaining to generation of strong fields, to plasma waveguides, and to the limiting beam-wave state with surface waves. The authors thank A. A. Kolomenskiy and A. A. Rukhadze for the discussion of the results. References 3: 2 Russian, 1 Western.
[197-2415]

UDC 533.9.082.5

TEMPERATURE AND VELOCITY OF PLASMA IONS IN CROSSED ELECTRIC AND MAGNETIC FIELDS

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 34, No 4, Apr 81 pp 610-612 manuscript received 3 Jun 80

ZVEREV, V. N., POLUEKTOV, N. P. and KHARCHENKO, V. N.

[Abstract] The paper gives the results of spectral measurements of the temperature and velocity of ions of a rotating argon plasma, and their time dependences. A facility of the Homopolar type was used with length of 20 cm, anode and cathode diameters of 8 and 1 cm, separated by quartz flanges. The external magnetic field was 0-1.4 T in the center, and 1.7 times higher at the flanges. The discharge was ignited in argon with initial pressure of 1-10 Pa from a 400 μF capacitor bank at a potential of 5 kV or less. The velocity and temperature determinations were made with a DFS-8 spectrograph with grating of 2400 lines/mm (dispersion of 0.13 nm/mm), FEU-71,79 photomultipliers, and an LI-602 dissector. The temperature dependences were obtained from profiles of the components of Zeeman splitting of the spectral lines. The average velocity of quasi-steady rotation of the plasma is three times the critical value. No large-scale inhomogeneities were observed. Figures 2, references 4: 3 Russian, 1 Western.
[170-6610]

THEORY OF SATELLITE INSTABILITY OF THE EQUILIBRIUM STATE OF A MODULATED BEAM IN PLASMA

Moscow FIZIKA PLAZMY in Russian Vol 7, No 1, Jan-Feb 81 pp 91-96
manuscript received 6 Mar 80

KUZELEV, M. V. and RUKHADZE, A. A., Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] When an electron beam interacts with a nonlinear plasma wave, the beam is broken up into bunches that oscillate at the minima of the wave field potential. Numerical analysis has shown that oscillations of captured particles in the field of the principal wave cause satellite instability that leads to excitation of waves with a frequency close to that of the particle oscillations. In this paper the authors analyze an analogous problem with consideration of the finite temperature of the beam electrons. A solution is found for the system of equations that describes the equilibrium state of an electron beam in a plasma in the presence of a plasma wave of finite amplitude stimulated by the beam itself. It is shown that accounting for temperature leads to a qualitative change in the pattern of instability development. First the equilibrium state of such a wave is found in the field of a strong plasma wave, and it is shown that the beam is density-modulated to form a system of nonoverlapping electron bunches within which the electrons oscillate at a frequency that depends on the amplitude of the plasma wave field and the beam modulation period. This equilibrium state of the beam in a plasma is unstable: electrostatic instability arises in the system with respect to decay of the space-charge beam wave into a plasma wave and its harmonics and the wave of electron oscillations in bunches--the analog of satellite instability but with consideration of the finite temperature of the electron beam. References 9 Russian.
[158-6610]

UDC 533.951.8

ABSOLUTE DECAY INSTABILITY IN A TWO-DIMENSIONALLY INHOMOGENEOUS PLASMA

Moscow FIZIKA PLAZMY in Russian Vol 7, No 1, Jan-Feb 81 pp 159-162
manuscript received 17 Mar 79

ANDREYEV, A. A., Optics Institute imeni S. I. Vavilov

[Abstract] Absolute instabilities have been theoretically analyzed for the case of a one-dimensionally inhomogeneous plasma, but when a laser beam acts on a flat target under experimental conditions, both the concentration and temperature of the plasma are most frequently functions of two variables. It has been demonstrated perviously that absolute instability exists in perturbations that interact with a two-dimensionally inhomogeneous pumping wave field in a homogeneous plasma. In this paper, an investigation is made of the process of decay of an electromagnetic wave into Langmuir and ionic-acoustic components in a plasma with concentration and temperature that are inhomogeneous with respect to two

coordinates. It is shown that the absolute instability stimulated by a powerful pumping wave arises because of localization of perturbations in a region bounded by caustic surfaces of the interacting waves. An expression is found for determining the thresholds and natural frequencies of absolute decay instabilities. The results of the analysis can be used to calculate the convective amplification of waves in a weakly inhomogeneous plasma under condition that the pumping is much lower than the level necessary for development of absolute instability. References 3 Russian.
[158-6610]

UDC 51.330.115

QUASILINEAR PROGRAMMING AND VECTOR OPTIMIZATION

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 257, No 4, 1981 pp 788-791
manuscript received 28 Nov 80

BULAVSKIY, V. A., Institute of Mathematics, Siberian Department, USSR Academy of Sciences, Novosibirsk

[Abstract] The author considers the linear programming problem $\min\{c'x: Ax \geq b, x \geq 0\}$, where $A \in R^{m \times n}$, $b \in R^m$ and $c \in R^n$ are given, and the vector $x \in R^n$ is the unknown. In operations research problems, the vector x is the plan to be selected, the right member of b is the clearly formulated assignment, and minimization of linear form c is the goal of optimization. Matrix A is the production function that transforms the selected plan to the final result. While the production function can be considered linear with considerable accuracy in many cases, it is sometimes unjustified to assume that the assignment is rigid or that the goal is an extremum. Circumvention of the latter assumption usually involves a choice of several optimality criteria, but solution of the resultant vector optimization problem usually involves reducing all these criteria to a single criterion by some means. An approach is proposed for solving this problem by using the dual linear programming problem $\max\{b'y: A'y \leq c, y \geq 0\}$, in which the vector of estimates y is found in space R^m. Instead of the fixed vectors b and c, the given quantities are the functions $b(x,y)$ and $c(x,y)$ that map $R^m \times R^n$ into R^m and R^n respectively. Then the following problem is formulated with conditions of complementarity: to find the pair $(x,y) \in R^m \times R^n$ that satisfies the conditions

$$Ax \geq b(x,y),\ x \geq 0,\ y'Ax = y' \cdot b(x,y),$$
$$A'y \leq c(x,y),\ y \geq 0,\ x'Ay = x' \cdot c(x,y).$$

The first two conditions in each of these groups of constraints define the admissability of x and y, and the last conditions of complementarity exchange minimization and maximization. This is called a quasilinear programming problem, and the function $b(x,y)$ can be treated as a demand function that responds both to estimates y of individual ingredients, and to the actually assumed plan x, while values of the function $c(x,y)$ are treated as acceptable specific expenditures for implementing each component of the plan. The relation between the quasilinear programming problem and the concept of the utility function is examined, and the linear problem of vector optimization is formulated. References 3: 1 Russian, 2 Western.
[176-6610]

CSO: 1862

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